



## MIT SCALE RESEARCH REPORT

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The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

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**Research Report: ZLC-2009-5**  
**Simulating risk propagation in a supply chain**  
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## Simulating risk propagation in a supply chain

Jorge Burdeus Embún

### EXECUTIVE SUMMARY

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**“In 2008, around seven companies went bankrupt everyday in Spain”**

Supply chain decisions are important issues in many industries because they can have a major impact on the value of the firm. Having the goal of being more efficient, forces the managers to look for new collaborators, even globalizing their operations. In addition, the uncertainty created by the worldwide financial crisis increases the external risk faced by companies. Considering these issues, it is imperative to perform an analysis to help determine best practices and policies for firms, especially trade credit policies, which involve risk between two echelons in a supply chain.

This thesis, which has primarily a theoretical focus and follows the latest trends of merging two historically separate disciplines, **finance and operations**, is aimed at understanding the behavior of the cost of capital, which measures the risk of the company. In this case, this risk involves the relationship with random external monetary factors and iteration with other echelons. In other words, gauging trade credit policies, we analyze **how the risk is transmitted in a supply chain**. Focusing on a link of a supply chain between manufacturer and retailer, we show what happens to an upstream firm if a downstream firm goes bankrupt.

Previous research has been carried out in this field, Serrano (2007) and Garza & Guardia (2008). We extend Serrano's investigation by adding a new echelon and Garza & Guardia's by focusing more on trade credit policies.

Building a valuation model to further this research consisted of two echelons maximizing the expected shareholders' value and using the Capital Asset Pricing Model (CAPM) as our main financial tool to assess risk; we run a simulation in order to examine the following issues:

- **Relationship between the cost of capital of an upstream firm and the time allowed to postpone the payments for the orders:** This scenario provides the evaluation of the negative influence coming from the possibility of bankruptcy of a downstream firm when trade credit policies are carried out.
- **Relationship between the values of the firms (individually and as a supply chain) and the trade credit policies:** This analysis helps us to evaluate the impact of the trade credit policies in a supply chain.

- **Relationship between the cost of capital of an upstream firm and the random monetary exogenous shocks disrupting its profits and the downstream firm's profits:** This scenario shows how, even facing deterministic and constant demand, the company can suffer disturbances from external factors.

### Major findings:

- Dealing with other parties and lending money within the supply chain brings a new risk into upstream firms. If the lower echelon of a link in the supply chain goes bankrupt, there is a possibility for the upper echelon of not collecting all the money. We revisit the coefficient *beta* of the upper echelon in order to include this risk. In addition, we show how due to trade credit policies, the initial investment of the shareholders increases because they have to finance the purchases of the batches related with the trade credit level allowed. Therefore, not only direct external shocks, but trade credit agreements, which indirectly include the random shocks of the downstream market, have an impact on the cost of capital for an upstream firm. Relating the cost of capital for the manufacturer and the trade credit agreements, we show how, the higher the delay allowed in payments, the lower the cost of capital for the upper echelon because the risk per dollar invested decreases.
- We also examine the value of a link of a supply chain. We show how it decreases when it is associated to longer trade credit agreements. As the potential losses due to bankruptcy increase, this situation destroys value into the supply chain. We also examine the impact of the value of the individual firms into this insight.
- Finally, when choosing the other echelon and agreeing trade credit policies, we expose the choices that the managers face. Not only is the requested delay in payments important but other issues are also, such as the risk of the market where the lower echelon operates or its internal policies. Aggressive dividends policies, which could imply an increase in the financial leverage, bring a higher cost of capital for the upper echelon.

We believe our thesis is very valuable to: supply chain managers searching for key partners to globalize their operations; managers seeking trade credit policies when dealing with other echelons; and academics and researchers willing to study topics that merge operations and finance.

Finally, we propose as **further research**, to extend our model by increasing the risk inserted in the supply chain; we recommend adding new echelons or allowing uncertainty in the demand. Therefore, the evaluation of possible collaboration policies between the echelons would be ideal to manage risk and reduce its potential impact in companies.